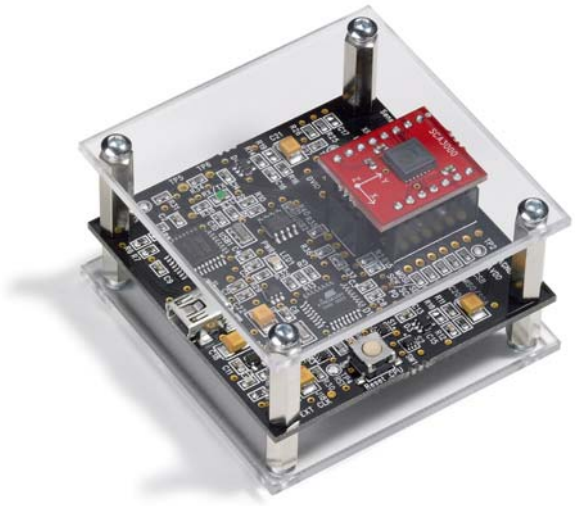
VTI TECHNOLOGIES

Doc.Nr. 8259300.10



SCA3000 DEMO KIT

User Manual

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1 Introduction

SCA3000 demo demonstrates the SCA3000 component functionality and the component key properties. This document describes how to install the required software and how to use the SCA3000 demo board and Graphical User Interface (GUI) software version 1.1.

SCA3000 demo consists of:

- SCA3000 sensor soldered on chip carrier PWB (see Figure 1 on next page)
- USB interface card (see Figure 1 on next page)
- USB cable
- GUI software running on PC

The SCA3000 DEMO KIT supports all SCA3000 series sensors: SCA3000-D01, SCA3000-D02, SCA3000-E01, SCA3000-E02 and SCA3000-E04. The evaluation boards (SCA3000 PWBs) are compatible with the SCA3000 DEMO KIT.

SCA3000 demo runs on Windows XP and 2000, it requires USB connection for data transfer. Demo is powered from USB port.

2 Quick start for using the SCA3000 DEMO KIT

Please follow the steps below:

1. Insert CD-ROM
2. Setup the hardware
   - Connect the demo kit to PC's USB port
3. Install the USB driver, after the PC has found the device
   - When the PC detects the new USB device, do not let Windows to detect the driver, address the USB driver from folder:
     `"CD-ROM\SCA3000 demo - Virtual Com Port Drivers\"`
   - NOTICE, if you have already installed the SCP1000 demo to your computer, please check that the latency timer parameter is 5 ms. In case the latency timer value is greater than 5 ms, the SCA3000 DEMO KIT GUI will not work (more detailed instructions in section 9)
4. Install the GUI software
   - Install the GUI software by running the "`setup.exe`" from folder:
     `CD-ROM\SCA3000 demo - ver 1.1 - Installer`
   - Do not change the installation destination
5. Start the GUI software
   - From Start → Programs → SCA3000-USB-DEMO-VER-1.1 → SCA3000-USB-DEMO-VER-1.1

When using the SCA3000 DEMO KIT with GUI software:

- The DEMO KIT should be connected to PC before the GUI software is started
- Exit the GUI software before unplugging the DEMO KIT from PC
- After GUI software is stopped, the DEMO KIT can be unplugged from PC (DEMO KIT uses virtual serial port driver, so it can not be found as a USB device).

3 Hardware

The SCA3000 DEMO KIT USB interface board (black PWB) and SCA3000 PWB (red PWB) are shown in Figure 1. The USB interface card converts the USB interface to SPI or I^2C interface. SCA3000 sensor is soldered on PWB which is connected to interface board.

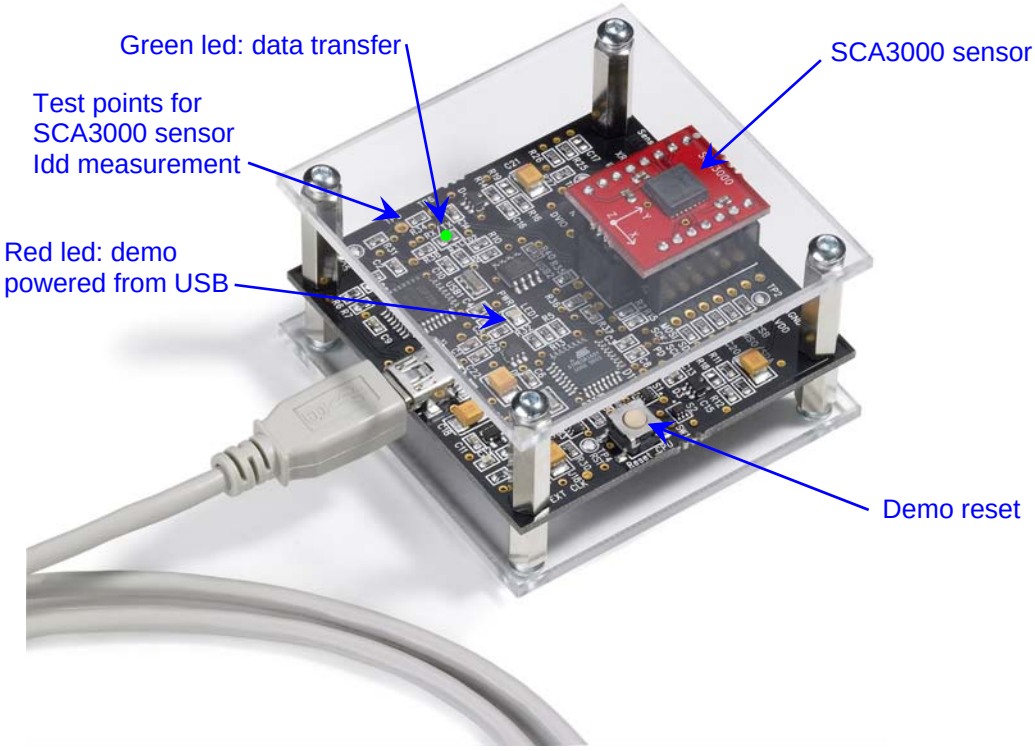


Figure 1. SCA3000 demo USB interface board and SCA3000 PWB.

4 GUI software

SCA3000 DEMO KIT is controlled via USB serial port by GUI software.

The GUI software has five different display modes. The SCA3000 sensor can be set to:

- normal measurement mode,
- normal measurement mode with free fall detection enabled and
- motion detection mode.

The interrupt detected due free fall or motion is indicated by led indicator and sound (if PC sounds are enabled). Once interrupt is detected, the interrupt has to be cleared by user by pressing the red led. The led appears on display only when the interrupt is detected.

The five different GUI displays and start up screens are presented below.

Screen capture of the GUI is presented in Figure 2.

Figure 2. SCA3000 DEMO KIT Graphical User Interface

Table 1. The numbered items in Figure 2.

Item	Description
1	Temperature display, if temperature information is available for the sensor.
2	Exit software, [Esc]-button also.
3	Data overflow; if the indicator is red, the acceleration register has overflow → measured acceleration is out of measuring range.
4	Resultant acceleration ON / OFF ($Res = \sqrt{x^2 + y^2 + z^2}$).
5	Save acceleration data in to text file.
6	Freeze image, start / stop the scrolling window, [Page-Up] button also.
7	Zero gravitation ON / OFF.
8	Open / close the window extension with arrow button (available only in SCROLL display).
9	Pull down menu for acceleration [g] range (Y-axis).
10	Selected sensor type and GUI software version number.
11	Averaging ON / OFF, number of samples for averaging.
12	Pull down menu for SCA3000 measurement mode
13	Pull down menu for GUI display mode

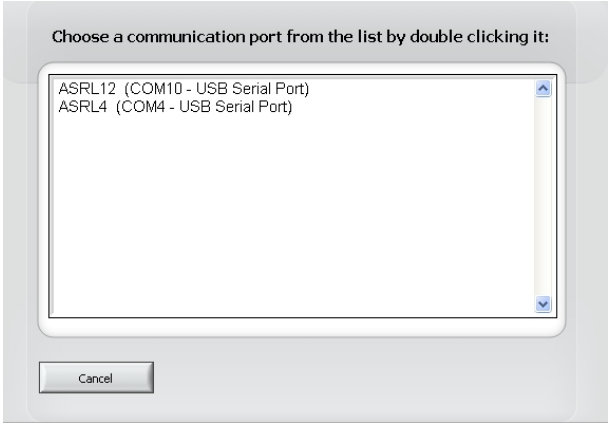

Choose a communication port from the list by double clicking it:
ASRL12 (COM10 - USB Serial Port)
ASRL4 (COM4 - USB Serial Port)
Cancel

Figure 3. USB serial port selection pop-up window.

If more than one USB serial port devices are connected to PC, user must select the correct **USB SERIAL PORT** from pop-up window (Figure 3). If user does not know the correct USB serial port number, please disconnect all other USB serial port devices from PC and restart the GUI software.

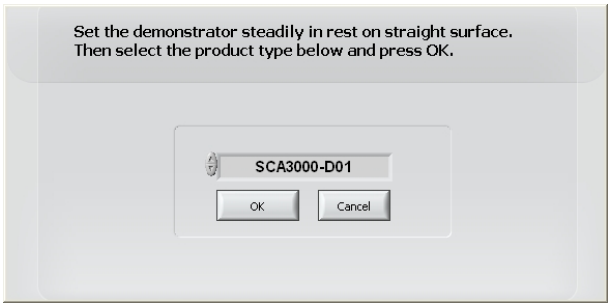

Set the demonstrator steadily in rest on straight surface.
Then select the product type below and press OK.
SCA3000-D01
OK
Cancel

Figure 4. Product selection pop-up window.

User needs to select the correct product type from **PRODUCT SELECTION** pop-up window (Figure 4). SCA3000-D01 is selected by default, product type can be found from top SCA3000 component, see Figure 1. Product selection affects on the used serial communication (SPI / I^2C) as well as the sensor output scaling to acceleration.

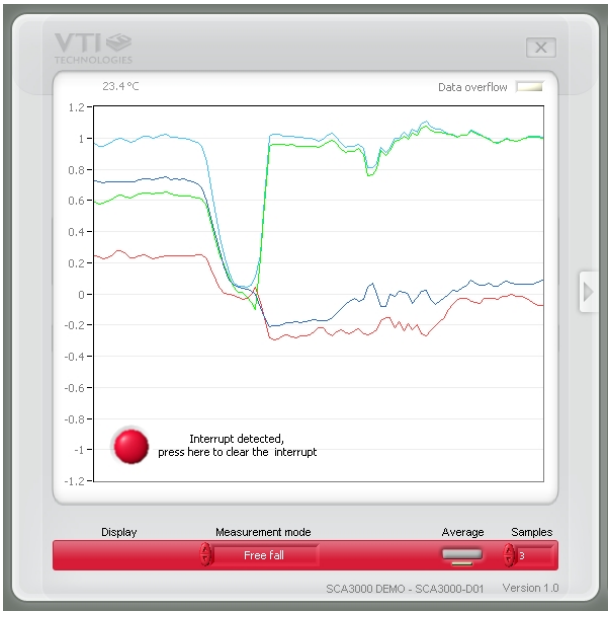


Figure 5. Scroll display with detected free fall.

SCROLL, continuously scrolling X, Y, Z and resultant accelerations, see Figure 5. Acceleration is presented in [g]. User can:

- change the acceleration scale
- freeze the scrolling image
- change the averaging factor
- set averaging OFF
- save acceleration data into file
- enable resultant scrolling
- detect which axis caused the interruption in motion detection mode (by clearing the interrupt)

Most of the actions/controls listed above are in the extension part of the window, which can be accessed by pressing the arrow button (see Figure 2 and Table 1).

The red led in the lower left corner in Figure 5 indicates the detected free fall. By pressing the red led the interrupt is cleared by reading the INT_STATUS register.

The pull down menu for different displays is disabled when free fall or motion detector mode is activated.

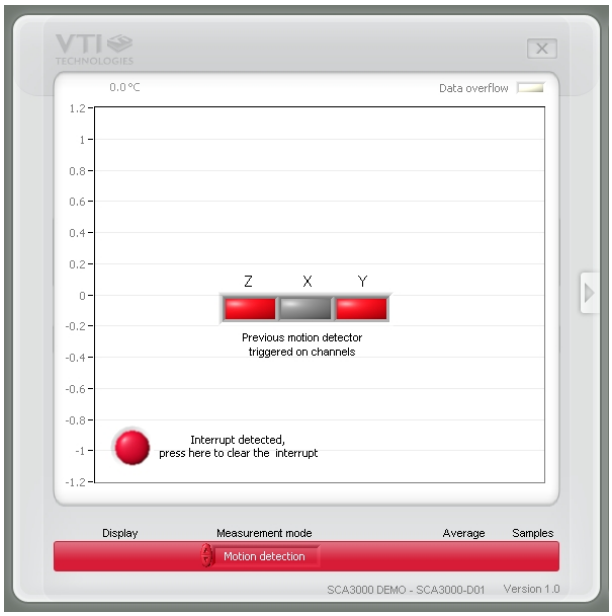


Figure 6. Scroll display with detected motion.

The red led in the lower left corner in Figure 6 indicates the detected motion. By pressing the red led the interrupt is cleared by reading the INT_STATUS register.

The INT_STATUS register contains the information of the interrupt cause. In Figure 6 Y- and Z-axis acceleration triggered the motion detector in previous time.

The pull down menu for different displays is disabled when free fall or motion detector mode is activated.

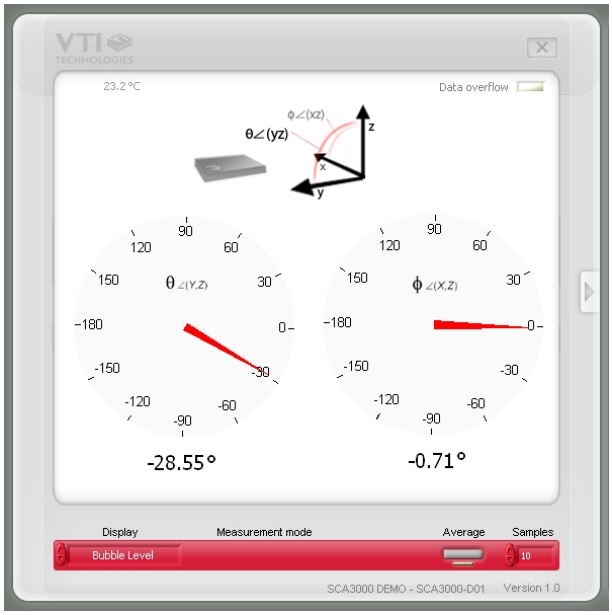


Figure 7. Bubble level display.

BUBBLE LEVEL, two displays that show tilt angle, see Figure 7. Angle calculation is performed in GUI, not in SCA3000 sensor.

SCA3000 sensor averaging can be enabled / disabled.

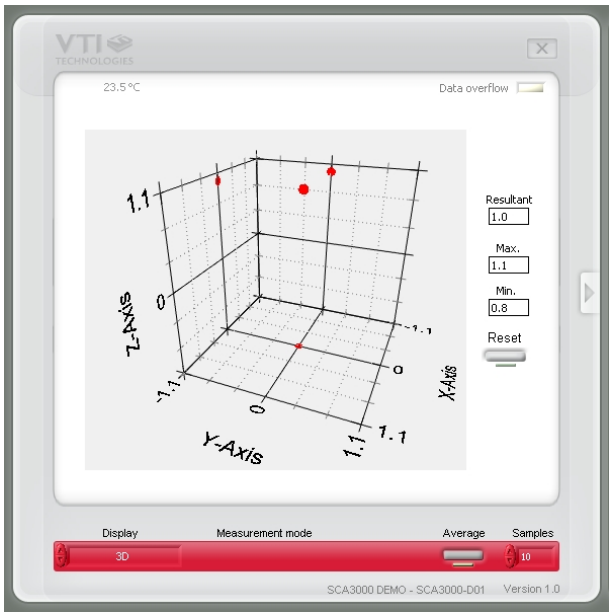


Figure 8. 3D display.

3D, 3 dimensional display with projections of each axis acceleration, see Figure 8.

The minimum and maximum resultant accelerations as well as the current resultant acceleration are displayed on the right side of the graph. Minimum and maximum displays can be cleared by pressing the "Reset" button.

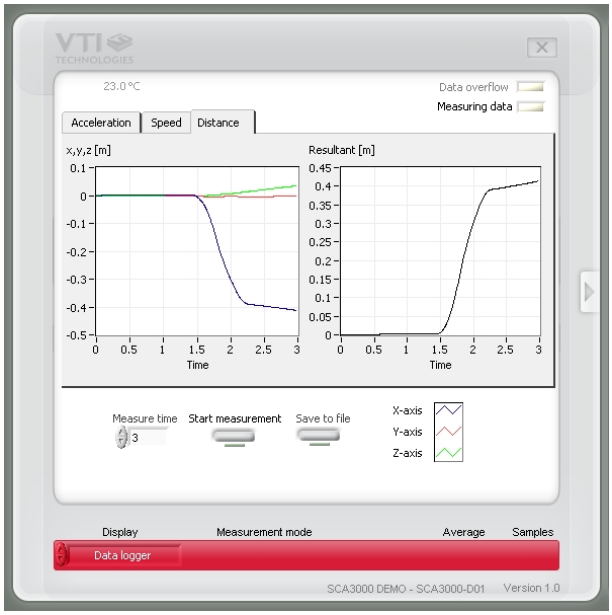


Figure 9. Data logger display.

DATA LOGGER, display where user can:
- log data (maximum log time 5 s)
- view the logged data in [g]
- view the demonstrator speed as a function time (speed [m/s] is derived by integrating the acceleration data)
- view the inertial navigation results (distance [m] as a function of time is derived by integrating the acceleration data twice)

To start the data logging press the "Start measurement" button. The actual data logging starts when the green "Measuring data" indicator lights up in the upper right corner of the window. Data is logged for predefined time period (“Measure time”). The results are calculated afterwards. The green "Measuring data" indicator is activated also during the result calculation.

The resultant (acceleration [g], speed [m/s] and distance [m]) is calculated from the respective 3-axis results as follows:

$$Res = \sqrt{x^2 + y^2 + z^2}$$

Please notice that inertial navigation contains six degrees of freedom and 3-axis accelerometer can handle only three degrees of freedom (rotations and tilting can not be detected when inertial navigation is performed only by 3-axis accelerometer).

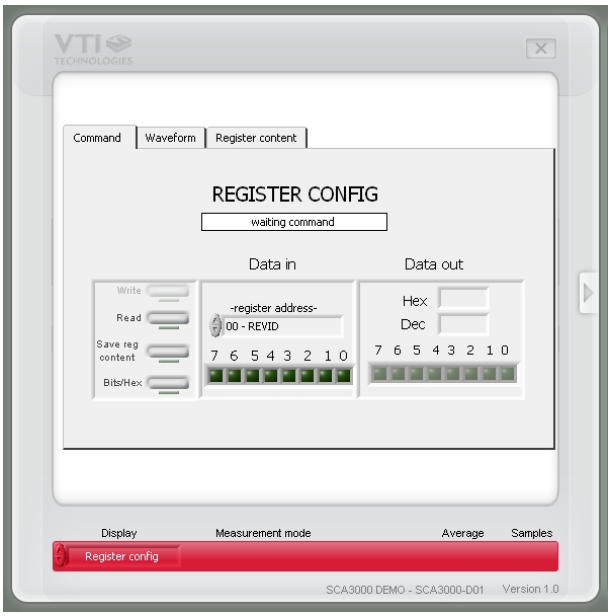


Figure 10. SCA3000 register configuration display.

REGISTER CONFIG display offers user access in to SCA3000 sensor internal registers. Registers can be read and written. The written data format can be changed between binary and hexadecimal by pressing the "Bits / Hex" button.

User can read automatically all configuration registers by pressing the “Save reg content” button. The results are saved into file and they can be viewed from “Register content” tab as well.

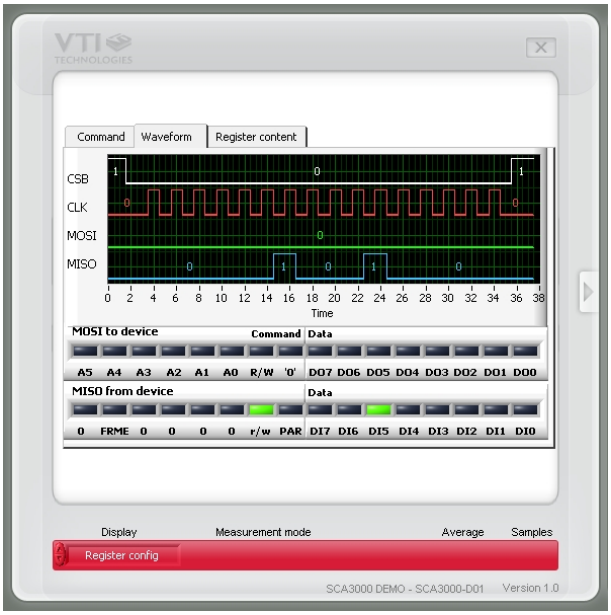


Figure 11. SCA3000 SPI waveforms in register configuration display.

SPI frame format for each operation can be viewed from “Waveform” tab (see Figure 11).

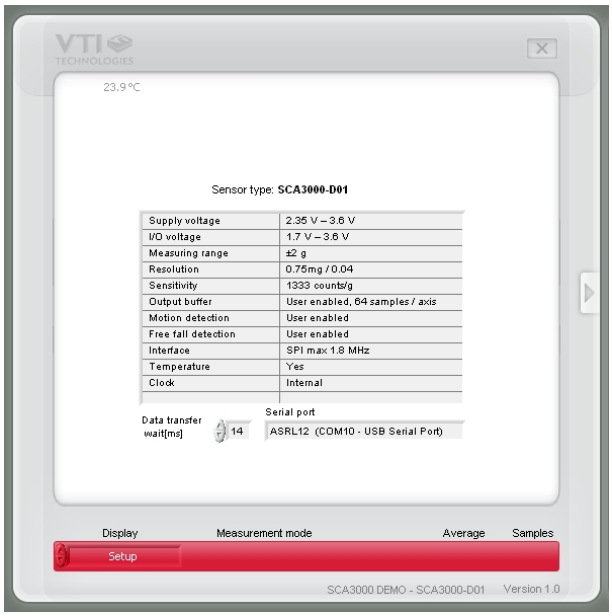


Figure 12. Setup display.

SETUP display presents some operational parameters of selected component type, please refer to component specific documentation for further information.

“Data transfer wait [ms]” is the delay in GUI software between the successive data readings from virtual serial port. If the GUI sw does not run properly, user can try if increasing this delay results in better GUI software functionality.

The used virtual serial COM port number can be viewed from "Serial port" display. This information is needed if the SCA3000 DEMO KIT is used without the GUI software, see further details from section 5.

In this example the SCA3000 DEMO KIT uses COM4 serial port.

Figure 13. Reset demo display.

RESET DEMO initialises the GUI software. µC software version is presented also. GUI revision 0.16.5 can be executed with µC software version 0.9.95. SCROLL display opens after RESET by default.

4.1 Resetting GUI and µC

SCA3000 DEMO KIT GUI software can be reinitialised by selecting the “Reset demo” display from pull down menu, see Figure 13.

µC can be resetted by exiting from the GUI and then pressing the reset button (Figure 1) on USB interface board.

4.2 Uninstalling the GUI and USB driver

The GUI software and the USB driver (FTDI Serial Converter Driver) can be removed from Windows Control Panel Add/Remove Programs. Please notice that removing the FTDI Serial Converter Driver (USB driver) may affect on functionality of some other programs (such as SCP1000 demo kit GUI).

5 Advanced data logging

Acceleration data can be saved from GUI software by pressing the “Save to file” button (Figure 2). Data can be logged also by using the Windows HyperTerminal software and macro language that is used to control the µC of the SCA3000 DEMO KIT.

Please notice that GUI software and Windows HyperTerminal software can not be open at the same time. Follow the steps below to start the data logging:

1. Connect SCA3000 DEMO KIT with USB cable to PC
2. Open GUI software to see the correct COM port number (SETUP display, see Figure 12).
3. Close the GUI software.
4. Open Windows HyperTerminal software from CD-ROM:
   - “SCA3000_demo_HyperTerminal_connection.ht”, or
   - see detailed serial communication settings from Table 2.
5. Press demo reset button (see Figure 1). SCA3000 DEMO KIT sends an info text to HyperTerminal (see Figure 14). If the HyperTerminal software is unable to connect the SCA3000 DEMO KIT or the info text does not appear,
   - Press disconnect ,
   - change the COM port number to correct from port properties
   - press connect ,
   - press reset button on SCA3000 DEMO KIT.

   until info text appears to HyperTerminal screen (see Figure 14).
6. After the info text appears on HyperTerminal, send text file “SCA3000_data_logger.txt” from CD-ROM (“Transfer” pull down menu → “Send Text File…” → browse for SCA3000_data_logger_macro.txt)
7. The text file is actually a macro that runs in an endless loop. The macro sends 3-axis acceleration data in hex format to HyperTerminal (see Figure 15). Example of data format:
   `0x1ef0,0x0130,0x01f0,Z-Y-X`
   where “0x” indicates for hex format, and “`Z-Y-X`” the axis order. The Z-axis hex output is 1EF0, which is ‘0001 1110 1111 0000’ in binary format.
8. The data can be stored by capturing the data in to file:
   “Transfer” pull down menu → “Capture Text…” → save captured data into wanted file and folder.
9. Data capturing can be stopped from:
   “Transfer” pull down menu → “Capture Text…” → “Stop”

Macro language is used to control the SCA3000 DEMO KIT. It can be also used to configure the SCA3000 sensor. For more detailed information of macro language, please refer to “SCA3000 DEMO KIT macro language description 8259200”.

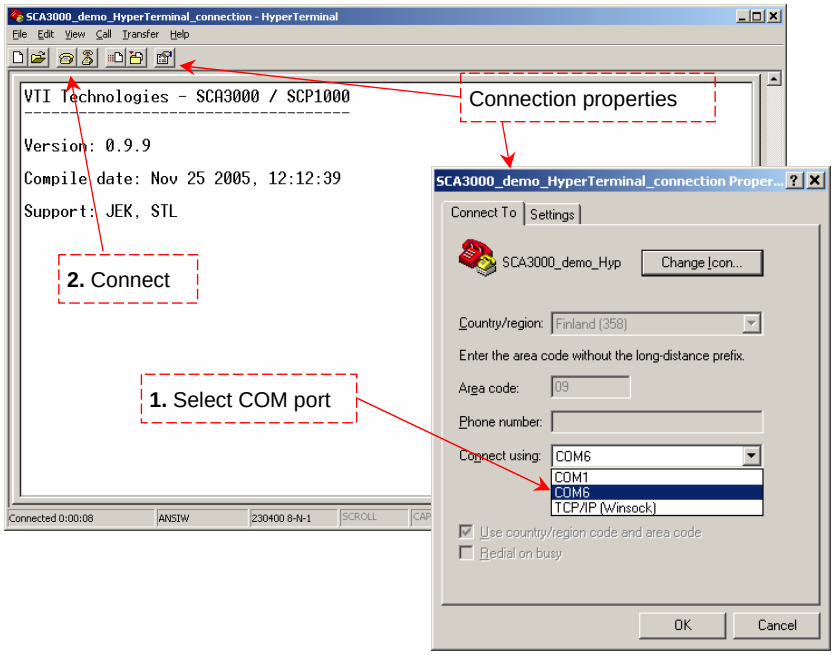


Figure 14. Windows HyperTerminal with SCA3000 demo info text.

If the pre-configured HyperTerminal connection is not available (the CD-ROM), the HyperTerminal connection can be opened also from:

→ Start → Programs → Accessories → Communications → HyperTerminal

The communication settings are presented in Table 2 below

Table 2. SCA3000 DEMO KIT serial communication settings.

Parameter	Value
Bits per second	230400
Data bits	8
Parity	None
Stop bits	1
Flow control	None

The correct COM port number depends on the PC and used USB port.

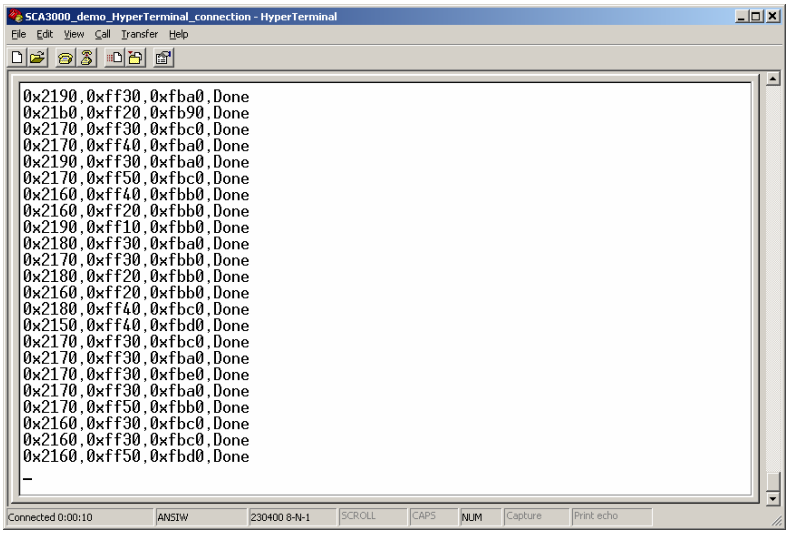


Figure 15. SCA3000 demo output during data logging.

6 SCA3000 current consumption measurement with DEMO KIT

The current consumption of the SCA3000 sensor can be calculated by measuring the voltage drop over the resistor R34 (470 Ω, 1% tolerance). Voltage drop can be measured from test points TP5 and TP6, see DEMO KIT USB interface board circuit diagram in Figure 18 (PCB design VTI 29393 rev B0).

The offset current consumption of the DEMO KIT hardware depends on used serial communication (SPI vs. I^2C). The offset current consumption according to serial communication type is presented in Table 3 below.

Table 3. Offset current consumption of the SCA3000 DEMO KIT HW.

Serial interface	Offset current consumption
SPI	~950 µA (V_{offset} = 444 mV)
I^2C	~200 µA (V_{offset} = 94 mV)

The offset current consumption can also be measured by measuring the voltage drop over the resistor R34 (TP5 and TP6, see Figure 18) when SCA3000 PWB is not connected to USB interface board.

SCA3000 current consumption can be calculated

$$Idd = \left(\frac{V_{drop} - V_{offset}}{470\,\Omega} \right), \quad (1)$$

where V_{drop} is the measured voltage drop in [V] (from TP5 to TP6, see Figure 18), V_{offset} is the measured offset current consumption (from TP5 to TP6, see Figure 18), alternatively the values from Table 3 can be used. Idd is the SCA3000 current consumption in [A].

The difference in offset current consumption is due the pull up resistor in SCK/SCL line (R2 in Figure 17). When using SPI-bus, the µC software drives the SCK/SCL line low when there is no communication, which results in increase in DEMO KIT offset current consumption (current through resistor R2 in Figure 17 from DVDD to GND). When I^2C is used, the µC releases the SCK/SCL line when there is no communication.

7 USB interface board circuit diagram

SCA3000 demo USB interface board circuit diagram is presented in following pages.

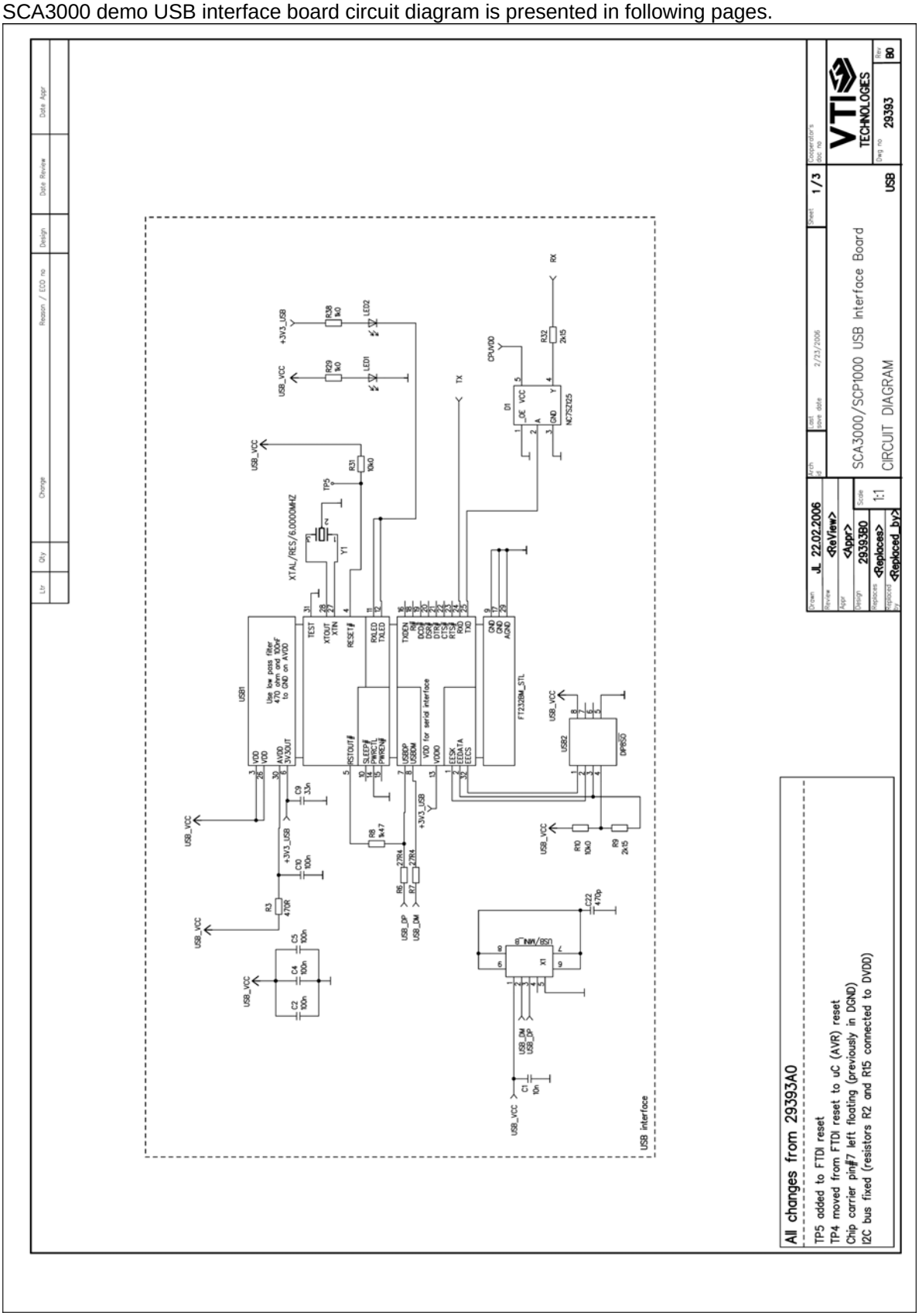


Figure 16. SCA3000 DEMO KIT USB interface board circuit diagram (sheet USB).

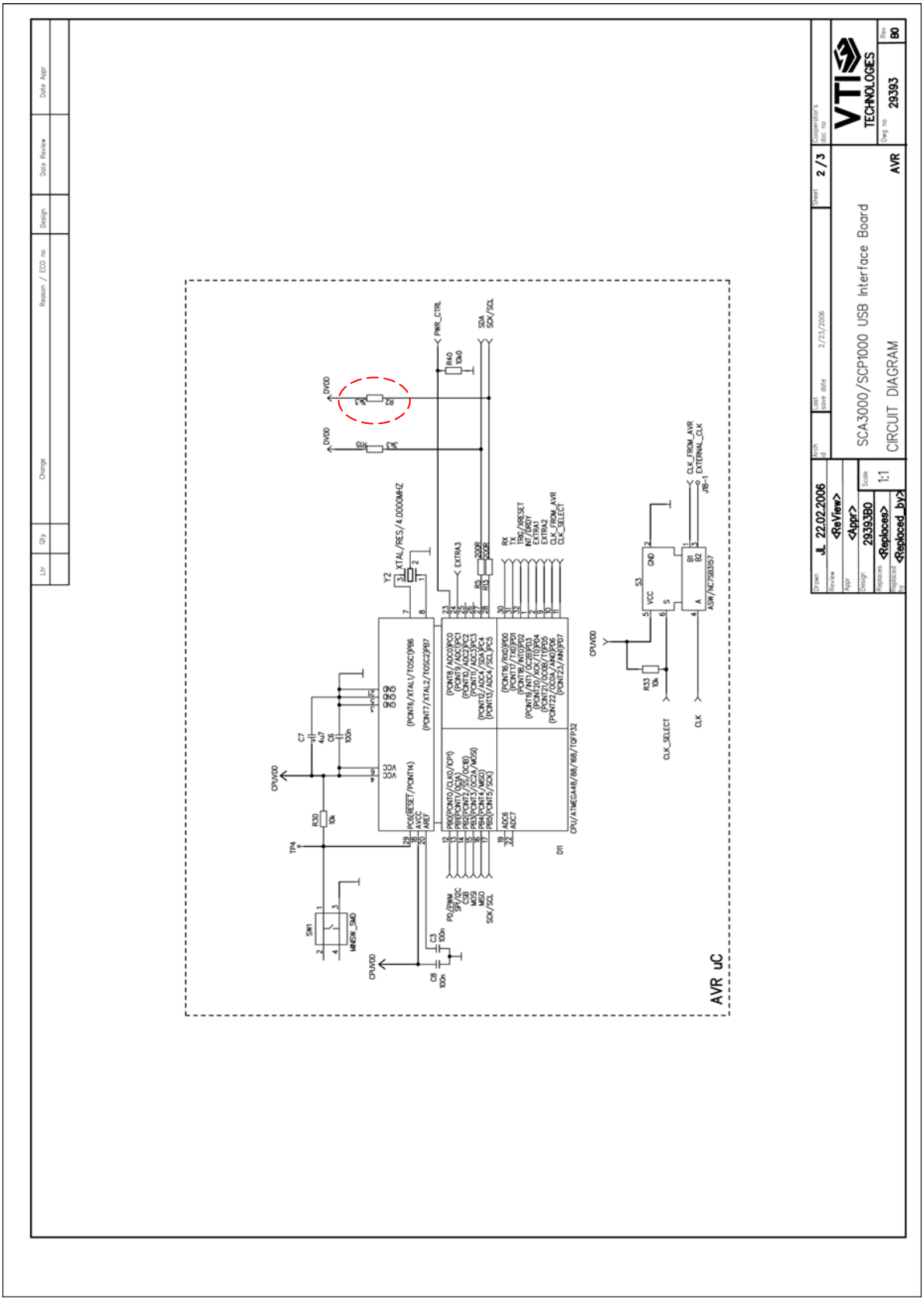


Figure 17. SCA3000 DEMO KIT USB interface board circuit diagram (sheet µC).

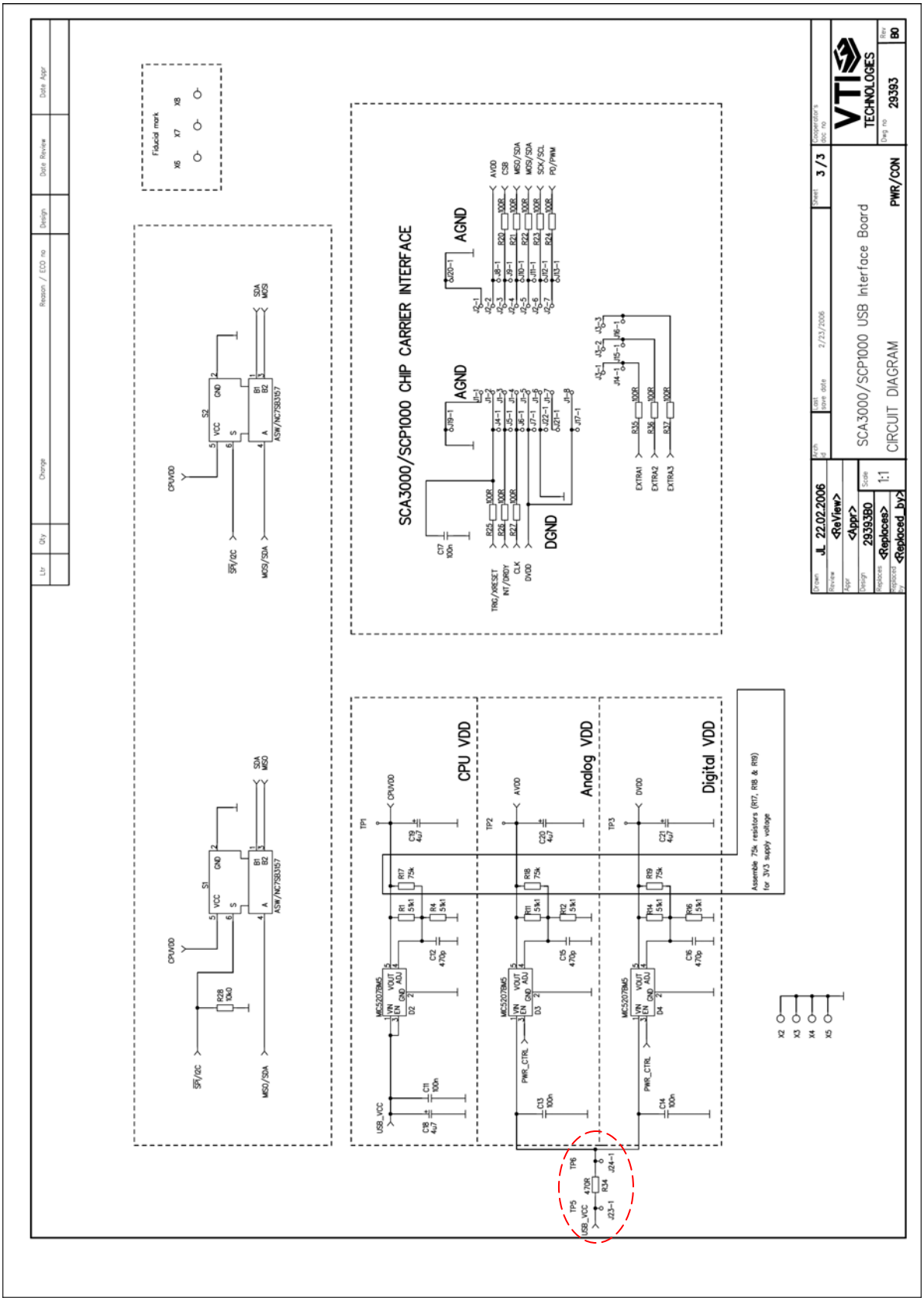


Figure 18. SCA3000 DEMO KIT USB interface board circuit diagram (sheet power).

8 USB interface board PWB layout

SCA3000 DEMO KIT USB interface board PWB layout and silkscreen is presented below.

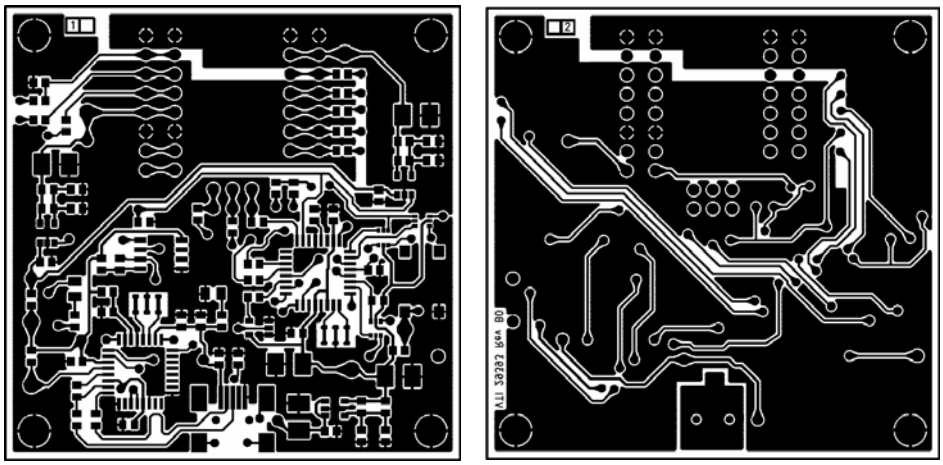


Figure 19. SCA3000 DEMO KIT USB interface board PWB layout.

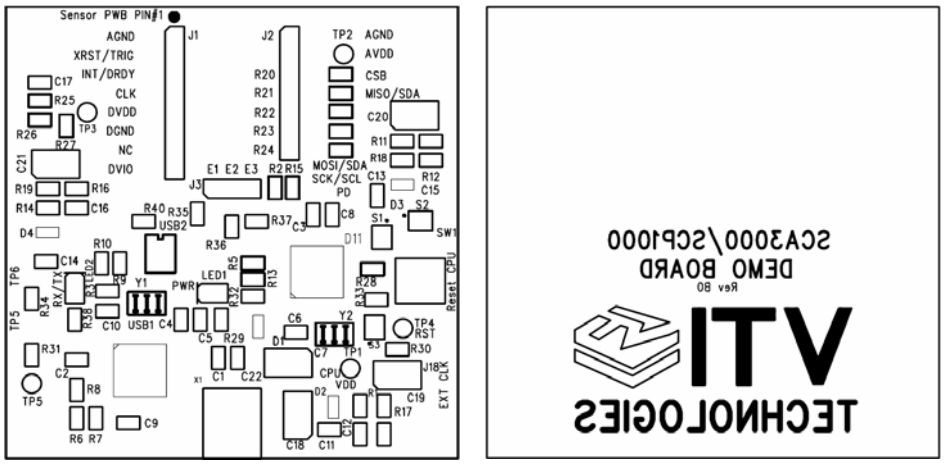


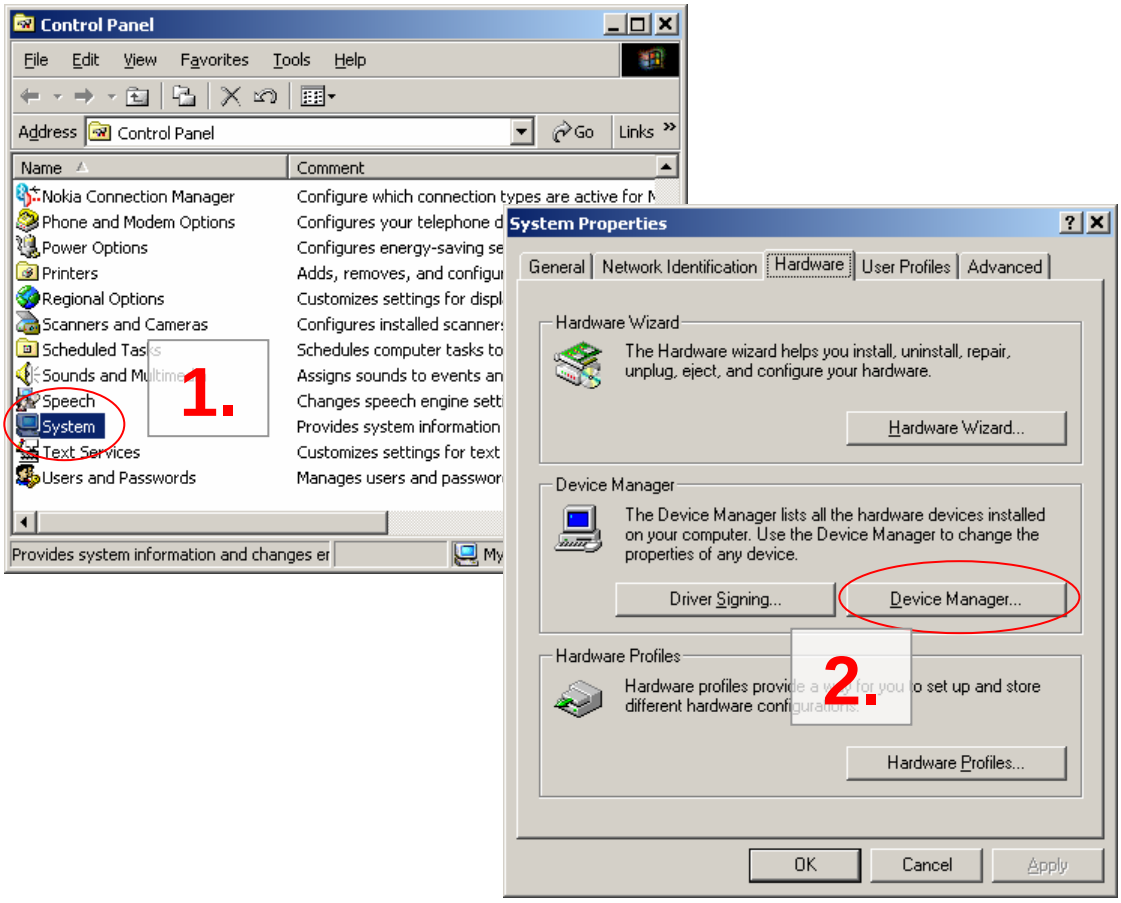
Figure 20. SCA3000 DEMO KIT USB interface board silkscreen.

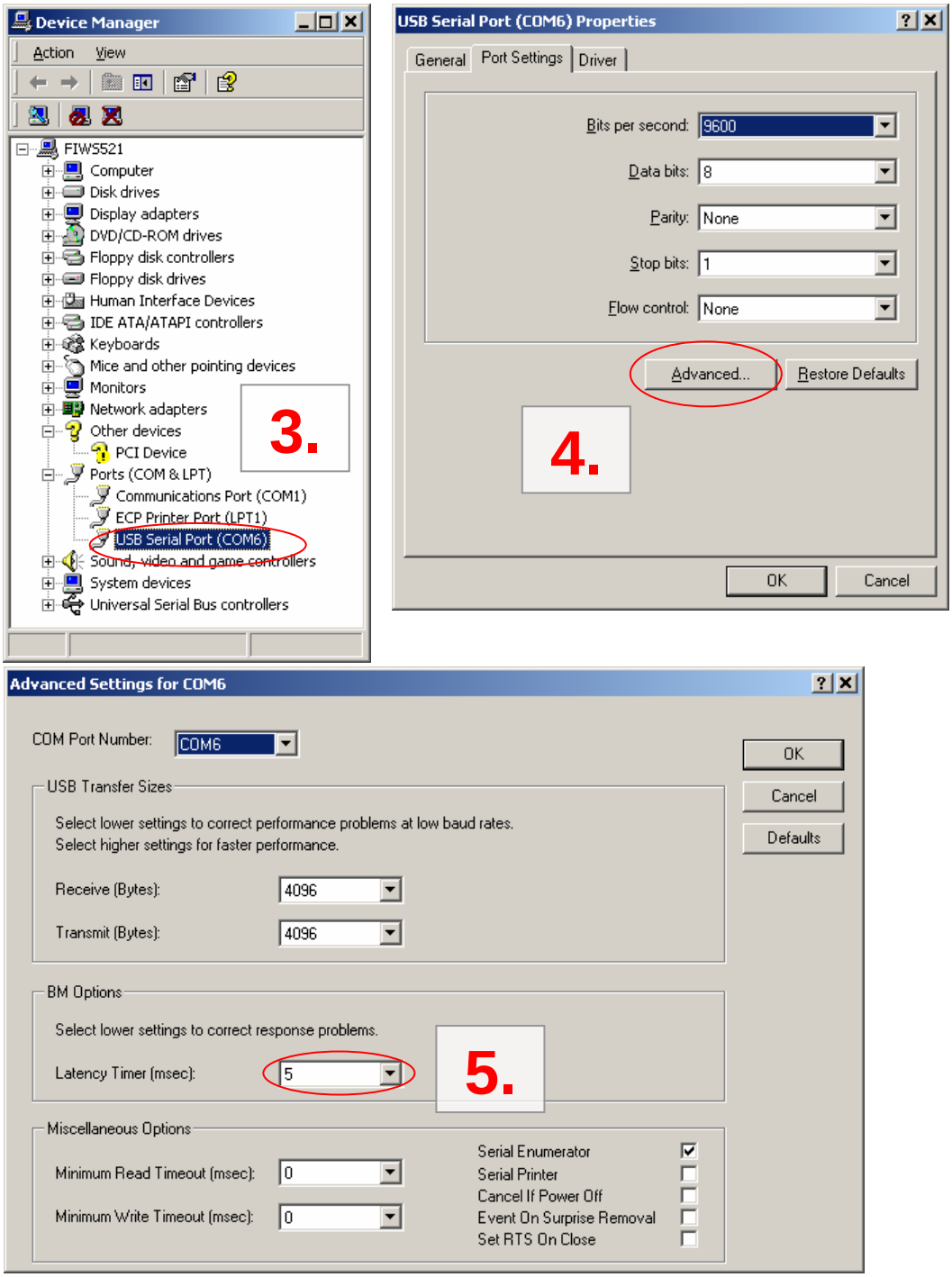
9 Troubleshooting

Due to many PC environments, the interoperability can be limited. The SCA3000 DEMO KIT has been tested with DELL laptops (Latitude D600, D610, D410) and desktop PCs with Win2000 and WinXP operating system. If the SCA3000 DEMO KIT does not work properly or it's operation is limited, the following items may help to sort the problems out:

- Stop the GUI software, press the reset button program on demo USB interface board (see Figure 1), re-start the GUI again.
- The wait time in data transfer can be in increased on "SETUP" display (GUI software pull down menu, see Figure 12).
- SCA3000 demo may not work properly if your PC has multiple USB serial ports installed. Please remove all other USB serial port devices (including SCP1000 demo).
- Close Windows HyperTerminal software, if you have used it.
- Check that USB driver LATENCY TIMER parameter is 5ms. Plug the demo USB cable in to PC and follow the steps (and screen captures) below:
  1. Open control panel and select "SYSTEM"
  2. Select "DEVICE MANAGER" from "HARDWARE" tab
  3. Select "USB SERIAL PORT" from the list, right mouse click and select "PROPERTIES"
  4. Select "ADVANVED" from the USB Serial port Properties
  5. Set the "LATENCY TIMER" to 5 ms (the 16ms default value is too slow for SCA3000 DEMO KIT).
  6. Press "OK" to all windows.
  7. Restart the GUI software.
  8. **NOTICE!** If the SCP1000 USB demo does not work properly with this 5 ms latency timer value, the value needs to be changed back to 16 ms.

Start → Settings → Control panel




Device Manager
Action View
FIWS521
Computer
Disk drives
Display adapters
DVD/CD-ROM drives
Floppy disk controllers
Floppy disk drives
Human Interface Devices
IDE ATA/ATAPI controllers
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Other devices
PCI Device
Ports (COM & LPT)
Communications Port (COM1)
ECP Printer Port (LPT1)
USB Serial Port (COM6)
Sound, video and game controllers
System devices
Universal Serial Bus controllers
3.
USB Serial Port (COM6) Properties
General
Port Settings
Driver
Bits per second: 9600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None
Advanced...
Restore Defaults
4.
OK
Cancel
Advanced Settings for COM6
COM Port Number: COM6
OK
Cancel
Defaults
USB Transfer Sizes
Select lower settings to correct performance problems at low baud rates.
Select higher settings for faster performance.
Receive (Bytes): 4096
Transmit (Bytes): 4096
BM Options
Select lower settings to correct response problems.
Latency Timer (msec): 5
5.
Miscellaneous Options
Minimum Read Timeout (msec): 0
Minimum Write Timeout (msec): 0
Serial Enumerator
Serial Printer
Cancel If Power Off
Event On Surprise Removal
Set RTS On Close

9.1 Known Issues

9.1.1 Floating SCA3000 CLK-pin

With MCU software version 0.9.95 the CLK-pin of SCA3000 (pin #4) is configured to floating instead of GND. SCA3000 will operate normally, but floating the CLK-pin may cause bigger current consumption values for SCA3000 than normally. If such thing is noticed, the CLK line (marked also on the silkscreen of the USB interface card) can be grounded.

This feature is fixed with MCU software version 0.9.95-r1.

9.1.2 Changing the serial bus type

The MCU needs to be reset (by pressing the reset button, see Figure 1) when changing between the two available serial bus types (SPI & I2C). This thing can happen when user changes the used SCA3000 component type.

9.1.3 Interference from USB communication

Capacitor C22 (Figure 16) connects the USB cable connector body to the GND net of the USB interface board. The capacitor value is updated from 470 pF to 100 nF in order to decrease the interferences in USB supply voltage (USB_VCC net in Figure 16). USB serial communication causes the interference in to the supply voltage provided by USB port.

The value of the capacitor C22 is 100 nF in the SCA3000 DEMO KITs that have been assembled since end of June 2006.

10 Document Revision History

Version	Date	Change Description
0.06	19.04.2006	Updated: - document template, minor language corrections
0.07	12.05.2006	Updated: - USB interface board updated (VTI29393B0), minor changes Current consumption measurement (section 6)
0.08	15.06.2006	GUI software version updated from version 0.16.4 to version 1.0 (visual update) Section "9.1 Known issues" added
0.09	28.06.2006	Updated: - Section "9.1 Known issues", Contact information
0.10	13.09.2006	GUI software version updated from 1.0 to 1.1. GUI sw ver 1.1 supports also SCA3000-E04 sensors

11 Contact Information

Finland
(head office)
VTI Technologies Oy
P.O. Box 27
Myllynkivenkuja 6
FI-01621 Vantaa
Finland
Tel. +358 9 879 181
Fax +358 9 8791 8791
E-mail: sales@vti.fi

Germany
VTI Technologies Oy
Branch Office Frankfurt
Rennbahnstrasse 72-74
D-60528 Frankfurt am Main,
Germany
Tel. +49 69 6786 880
Fax +49 69 6786 8829
E-mail: sales.de@vti.fi

USA
VTI Technologies, Inc.
One Park Lane Blvd.
Suite 804 - East Tower
Dearborn, MI 48126
USA
Tel. +1 313 425 0850
Fax +1 313 425 0860
E-mail: sales@vtitechnologies.com

Japan
VTI Technologies Oy
Tokyo Office
Tokyo-to, Minato-ku 2-7-16
Bureau Toranomon 401
105-0001
Japan
Tel. +81 3 6277 6618
Fax +81 3 6277 6619
E-mail: sales.japan@vti.fi

China
VTI Technologies Shanghai Office
6th floor, Room 618
780 Cailun Lu
Pudong New Area
201203 Shanghai
P.R. China
Tel. +86 21 5132 0417
Fax +86 21 513 20 416
E-mail: sales.china@vti.fi

To find out your local sales representative visit www.vti.fi